

1 WHAT IS CLAIMED IS:  
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1 1. A control system for processing sampled servo data in a disk drive, the control  
2 system comprising:

3 a microprocessor for executing firmware code; and  
4 an accelerator circuit for performing operations on the sampled servo data while  
5 the microprocessor is executing the firmware code, the accelerator circuit comprising  
6 a position error signal (PES) calculator circuit for calculating a PES value  
7 based on the sampled servo data; and

8 a write unsafe (WUS) estimator responsive to the calculated PES value  
9 and to a WUS limit parameter, the WUS estimator further for signaling the  
10 microprocessor when the calculated PES value exceeds the WUS limit parameter.

1 2. A control system for processing sampled servo data as defined in claim 1, further  
2 comprising a bus for transmitting the WUS limit parameter from the microprocessor to the  
3 accelerator circuit.

1 3. A control system for processing sampled servo data as defined in claim 1, wherein  
2 the accelerator circuit further comprises a WUS limit register for storing the WUS limit  
3 parameter.

1 4. A control system for processing sampled servo data as defined in claim 1, wherein  
2 the accelerator circuit further comprises a PES register for storing the calculated PES value.

1 5. A control system for processing sampled servo data as defined in claim 1, wherein  
2 the PES value is further based on a parameter stored in a parameter register.

1 6. A control system for processing sampled servo data as defined in claim 1, wherein  
2 the servo processing accelerator circuit has a plurality of multipliers that may simultaneously  
3 perform parallel calculations.

1           7.     A control system for processing data from sampled servo wedges for positioning a  
2 transducer head in a disk drive, the control system comprising:

3                   a microprocessor for executing firmware code; and  
4                   a servo processing accelerator circuit for executing servo processing functions  
5 while the microprocessor is executing the firmware code, the servo processing accelerator circuit  
6 comprising

7                           a position error signal (PES) calculator circuit for calculating a stream of  
8 PES values based on data read from the sampled servo wedges;

9                           a servo-loop compensator for processing the stream of PES values and  
10 generating a stream of control effort values for positioning the transducer head during a  
11 track following operation.

1           8.     A control system for processing data from sampled servo wedges as defined in  
2 claim 7, wherein the PES values are further based on parameters stored in corresponding  
3 parameter registers.

1           9.     A control system for processing data from sampled servo wedges as defined in  
2 claim 7, wherein the servo processing accelerator circuit has a plurality of multipliers that may  
3 simultaneously perform parallel calculations.

1           10.    A control system for processing data from sampled servo wedges for positioning a  
2 transducer head in a disk drive, the control system comprising:

3                   a microprocessor for executing firmware code; and  
4                   a servo processing accelerator circuit for executing servo processing functions  
5 while the microprocessor is executing the firmware code, the servo processing accelerator circuit  
6 including a servo-loop compensator for receiving a stream of PES values based on data read  
7 from the sampled servo wedges and generating a stream of control effort values based on the  
8 stream of PES values for positioning the transducer head during a track following operation.

1           11.    A control system for processing data from sampled servo wedges as defined in  
2 claim 10, wherein the PES values are further based on parameters stored in corresponding  
3 parameter registers.

1           12.    A control system for processing data from sampled servo wedges as defined in  
2 claim 10, wherein the servo processing accelerator circuit has a plurality of multipliers that may  
3 simultaneously perform parallel calculations.

1           13.    A magnetic disk drive, comprising:  
2                   a head disk assembly (HDA) including  
3                         a rotating magnetic disk having distributed position information in a  
4                   plurality of uniformly spaced-apart servo wedges for defining data storage tracks,  
5                         an actuator for positioning a transducer head in response to a control effort  
6                   signal, the transducer head for periodically reading the distributed position information  
7                   from the servo wedges and reading data from the data storage tracks; and  
8                         a control system having  
9                         an accelerator circuit for implementing a first sampled servo controller for  
10                   periodically adjusting, only during a track-following operation under one or more of a  
11                   first set of predetermined conditions, the control effort signal based on the distributed  
12                   position information, and for indicating the occurrence of a predetermined condition  
13                   within a second set of predetermined conditions to the control system;  
14                         a second sampled servo controller, separate from the accelerator circuit, for  
15                   periodically adjusting the control effort signal based on the distributed position information  
16                   during a track-following operation under one or more of the second set of predetermined  
17                   conditions.

1           14.    A magnetic disk drive as defined in claim 13, wherein  
2                   the control system further includes a disk controller for controlling disk  
3                   operations and a host interface for coupling the disk controller with a host system; and  
4                         the second sampled servo controller, the disk controller and the host interface are  
5                   implemented by a microprocessor that is separate from the accelerator circuit.

1           15.    A magnetic disk drive as defined in claim 13, wherein the second sampled servo  
2                   controller is implemented by the microprocessor using firmware code.

1           16.     A magnetic disk drive as defined in claim 13, wherein the accelerator circuit has a  
2 plurality of multipliers that may simultaneously perform parallel calculations.

1           17.     A magnetic disk drive as defined in claim 13 wherein the first set of  
2 predetermined conditions includes track following within a write unsafe limit.

1           18.     A magnetic disk drive as defined in claim 13 wherein the second set of  
2 predetermined conditions includes track following outside of a write unsafe limit.

1           19.     A magnetic disk drive as defined in claim 13, wherein, after receiving distributed  
2 position information in a servo wedge, the first sampled servo controller can adjust the control  
3 effort signal after a first processing delay and the second sampled servo controller can adjust the  
4 control effort signal after a second processing delay, wherein the first processing delay is less  
5 than the second processing delay.

1           20.     A magnetic disk drive as defined in claim 19, wherein the first processing delay is  
2 less than one-tenth of the second processing delay.

1           21.     A magnetic disk drive as defined in claim 19, wherein the first processing delay is  
2 less than one-fourth of the second processing delay.

1        22.    A magnetic disk drive, comprising:  
2                a head disk assembly (HDA) including  
3                        a rotating magnetic disk having distributed position information in a  
4        plurality of uniformly spaced-apart servo wedges for defining data storage tracks,  
5                        an actuator for positioning a transducer head in response to a control effort  
6        signal, the transducer head for periodically reading the distributed position information  
7        from the servo wedges and reading data from the data storage tracks; and  
8                a control system having  
9                        an accelerator circuit for implementing a first sampled servo controller for  
10        periodically adjusting, only during a track-following operation under one or more of a  
11        first set of predetermined conditions, the control effort signal based on the distributed  
12        position information with a first processing delay;  
13                        a microprocessor, separate from the accelerator circuit, for implementing a  
14        second sampled servo controller using firmware code for periodically adjusting the  
15        control effort signal based on the distributed position information, with a second  
16        processing delay that is substantially greater than the first processing delay, during an  
17        operation under one or more of a second set of predetermined conditions;  
18        wherein the control system selects the first sampled servo controller for adjusting  
19        the control effort signal during a track-following operation under one or more of a first set of  
20        predetermined conditions, and selects the second sampled servo controller for adjusting the  
21        control effort signal during an operation under one or more of a second set of predetermined  
22        conditions.

1        23.    A magnetic disk drive as defined in claim 22, wherein the first processing delay is  
2        less than one-tenth of the second processing delay.

1        24.    A magnetic disk drive as defined in claim 22, wherein the first processing delay is  
2        less than one-fourth of the second processing delay.

1           25.    A magnetic disk drive as defined in claim 22, wherein  
2                    the control system further includes a disk controller for controlling disk  
3 operations and a host interface for coupling the disk controller with a host system; and  
4                    the second sampled servo controller, the disk controller and the host interface are  
5 implemented by a microprocessor that is separate from the accelerator circuit.

1           26.    A magnetic disk drive as defined in claim 22, wherein the second sampled servo  
2 controller is implemented by the microprocessor using firmware code.

1           27.    A magnetic disk drive as defined in claim 22, wherein the accelerator circuit has a  
2 plurality of multipliers that may simultaneously perform parallel calculations.

1           28.    A magnetic disk drive as defined in claim 22 wherein the first set of  
2 predetermined conditions includes track following within a write unsafe limit.

1           29.    A magnetic disk drive as defined in claim 22 wherein the second set of  
2 predetermined conditions includes track following outside of a write unsafe limit.